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Selfish now, or altruistic (for) tomorrow? *Inter* vs. *intra*-generational strategies for the conservation of a common resource

Ivan Ajdukovic, Eli Spiegelman, Angela Sutan

La protection de l'environnement passe par la mise en œuvre d'actions coûteuses, au profit de personnes parfois inconnues et éloignées dans le temps. Ces actions pourraient sembler irrationnelles, sauf dans le cas où un individu chercherait à protéger le bien-être de proches, dans de futures générations. Nous comparons expérimentalement deux situations d'exploitation d'une ressource commune : les individus extracteurs sont membres de générations qui se suivent, sans lien dynastique (1) ; les individus des diverses générations sont membres de dynasties (2). Les individus qui savent que leur décision d'extraction va impacter les membres de leur dynastie appartenant à des générations futures font une extraction significativement moindre que les autres.

SELFISH NOW, OR ALTRUISTIC (FOR) TOMORROW? INTER VS. INTRA-GENERATIONAL STRATEGIES FOR THE PRESERVATION OF A COMMON RESOURCE

Environmental protection requires costly actions taken for other people's benefit. Those actions are irrational for selfish individuals, but may not be for those who care for the well-being of people close to them, for instance in next generations. We compare two situations of exploitation of a common resource: a situation in which individuals are members of successive generations, without dynastic link (1), and a situation in which individuals of various generations are members of dynasties (2). Our results show that individuals who know that their extraction decision will impact members of their dynasty belonging to future generations make a significantly lower extraction than others.

Mots-clés : générations, environnement, dynastie, ressource commune.

Keywords : generation, environment, dynasty, common resource.

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[aCEREN], EA 7477, Burgundy School of Business - Université Bourgogne Franche-Comté.

INTRODUCTION

The well-being of future generations is both one of the most important points of tension in addressing environmental issues through market mechanisms and one of the main reasons for addressing them. Coase's famous theorem shows that, ideally, externality problems can be solved by free trade with an arbitrary allocation of property rights upstream. When agents are given the opportunity to negotiate with each other without transaction costs, the allocation of final costs is independent of the allocation of rights at the outset. Yet, since the Brundtland Report (Keeble, 1988) to the present day, the foundations of "sustainable development" have been designed to preserve the ability of future generations to enjoy opportunities equal to ours. However, it is clear that the inability of future generations to negotiate with current generations leads to less than optimistic forecasts for the future. Moreover, in an emotional way, when we ask the question of *why we must protect natural resources? the* intuitive answer is *so that our children can have them*. This asymmetry is all the more important as the resources in question are renewable. The allocation of non-renewable resources is essentially a zero-sum game, while the degradation of an ecosystem's ability to provide a renewable resource has a social cost in terms of efficiency that increases with the number of future generations impacted. By experimentally inducing links between "generations" of participants, we enrich this literature by showing the benefits that these emotional links can have on individuals' behaviours. We demonstrate that, even on the basis of experimentally induced, labile links, we observe an effect on the ability of anonymous individuals to protect a renewable but degradable common resource.

Our current actions therefore have an impact on future individuals, whether in the context of contributions to the public good (Grolleau et al.,[2016]) or in the case of the extraction of common resources (Lohéac et al.,[2017]). These authors have shown that individuals are more responsible in inter-temporal contexts than in intra-temporal contexts. But although it seems to lead individuals to more sustainable behaviours, knowledge of an inter-temporal link with other individuals does not seem to solve the "tragedy of the commons". Fisher et al ([2004], p. 1) have shown in particular that "*the intergenerational dimension leads to responsible behaviour, but is not sufficient to achieve the social optimum. The presence of an intergenerational link leads individuals to expect less exploitation, but unfortunately these expectations are too optimistic, especially in the case of slow reproductive resources, where stowaway behaviour is predominant*. In continuity, Hauser et al.[2014] show that, in a context very similar to ours, a common resource is almost always immediately destroyed by anonymous individuals, including when they are informed that other individuals depend on its protection.

The limitation of this work is that the intertemporal link is limited to the sharing of a common resource. They incorporate the cost of intergenerational dilemmas, without considering the benefits. If we consider that one of the main reasons for protecting a resource is to leave it to our children, then it becomes interesting to know if this intergenerational *(dynastic)* link can lead to better resource protection. In this case, intergenerational arguments could be considered as "catalysts" for environmentally responsible behaviour.

According to the Larousse definition, a *dynasty* is a temporal sequence of people belonging to the same family, by extension to the same group, and who carry out the same activity. This leads to an *intergenerational* link structure: a member of a generation is linked to members of past or future generations through the internal link of the dynasty to which they all belong. On the other hand, the strict definition of *generation* circumscribes a set of people living at the same time, without any mandatory requirement of a dynastic link with the past or the future. This leads to an *intra-generational* link structure: generations follow each other in unrelated sequences. It is by comparing the extraction strategies used by these two types of relationships (dynasty, generation) that we will be able to quantify the willingness to preserve a common resource to allow a relative to benefit from it in the future.

LITERATURE REVIEW

Starting from the problem formalized by Gordon[1954], Ostrom (for a synthesis, see Ostrom[2015]) works on a *common pool resource extraction* game (CPR). Based on a set of strict definition rules, the CPR is considered a complete explanatory model of this type of decision (Gardener et al.,[1990]). The success of the CPR game is explained by its ability to replicate in the laboratory, in a simple way, real situations in which a common resource is not easily excluded, but has at least partial rivalry.[1] In such situations (*e.g.* exploitation of the seas; greenhouse gas emissions; etc.), the social cost of exploiting the resource may be greater than the individual cost, leading to its overexploitation and a decrease in the social benefit compared to its optimal level.

In a traditional CPR set, common resources are defined as resources from which it is costly (but not necessarily impossible) to exclude potential beneficiaries. When individuals use these common resources, the social cost takes the form of a *congestion* effect: the benefit for each user decreases for each unit exploited by each other. Individual rational users continue to extract as long as the cost of extraction is lower than the private benefit, without taking social cost into account. As a result, users eventually remove more resource units than is optimal from the perspective of the entire population that would have access to them (Olson,[1965]). It is this dilemma that leads to the "tragedy of the commons" (Hardin,[1968]), namely the exhaustion and/or non-renewal of the resource.

The two types of links defined in the introduction (*intra* and *inter*) could lead to different uses of resources. The underlying social phenomenon of such an effect is related to social distance. Social proximity has long been considered as a trigger for prosocial norms (Wade-Benzonie,[2003]; Charness et al.,[2007]; Hoffman et al.,[2008]; Fiedler et al.,[2011]; Wu et al.,[2011]; Ahmed,[2007]; Mackie and Cooper,[1984]; Brewer,[1979] ; Ferguson and Kelley,[1964]). This translates into a sense of "us" that comes from a shared social identity, and "*reduces the tendency to make distinctions between one's own well-being and that of others*" (Simpson,[2006], p. 444). Many studies have observed such effects, considered biases in favour of home group members (Yamagishi and Mifune,[2008]; Koopmans and Rebers,[2009]; Ben-Ner et al.,[2009]). This endo-favouritism can manifest itself in several ways: Waldzus et al.[2005] show that subjects accentuate the positive characteristics of their group, and the negative characteristics of others; Ben-Ner et al. 2009] show greater conditional cooperation with home group members; Kramer and Brewer[1984] observe that public goods in the same group receive greater contributions; Mackie and Cooper[1984] observe that hearing a member of their group express an opinion makes it more attractive; and Ferguson and Kelly[1964] conclude that individuals perceive the products produced by their group members as being of superior quality. Finally, Chen and Li[2009] find that matching in a group generates less desire, and a greater tendency to maximize the common good. However, it should be noted that most of these observations are due to the sense of belonging to the group that participants develop during the experience.

It is through the *Paradigm of Minimal Groups* (PGM, Tajfel,[1974]) that this sense of belonging to a group is created, aiming by extension to reduce social distance. This method consists of forming purely random groups, using for example preferences for Klee's or Kandinsky's paintings. The aim is to isolate a "pure" group effect. On the other hand, other authors have induced social

[1] Rivalry and exclusion being the well-known dimensions of the public good problem, which make market allocations ineffective.

proximity by seeing the face of a co-participant (Eckel and Grossman,[1996]; Eckel et al.,[2001]; Eckel,[2007]; Eckel and Petrie,[2008]).

On the basis of these elements, we have created a protocol to vary the social proximity between participants, in order to quantify its impact on decisions to extract a common resource over several generations.

METHODOLOGICAL CHOICES

We have implemented a modified CPR. In our experience, extraction presents a problem of social dilemma under the following conditions: (i) extractors consider the results of their own extraction strategies as socially sub-optimal, while (ii) there is at least one set of coordinated and achievable strategies that are more effective. More specifically, (iii) the extraction of a resource unit by one individual makes the resource at least partially unusable by another individual in the present or future, and (iv) multiple extractors exploit the resource in a concomitant or sequential manner.

Our work focuses on an intertemporal problem. In our experience, there is no congestion for the extractors of the resource at a given time t. All individuals can extract their maximum without affecting the possibilities of others who extract at the same time. On the other hand, intertemporal congestion is high: an over-extraction at period t (more precisely defined later) removes the possibility for participants to extract at periods $t + 1$, $t + 2$... We therefore focus on the first of the conditions of existence of the social dilemma mentioned above: how to modify the extractors' strategies to reduce the share of personal gains that is made at the expense of others, and by extension lead to a more efficient exploitation of the resource? We compare two situations: a situation in which the extractive individuals are members of a generation in a series of instantaneous generations, without dynastic link, and a situation in which the dynastic links are induced by the experimental protocol, in order to modulate social distance.

Our study aims to reduce the social distance between some participants, either by creating exogenous links that extend over time (*inter,* or in a *dynasty*), or by placing individuals in the same generation (*intra* or in a *generation*). By creating an intergenerational bond, or dynasty, it will be possible to reduce the social distance between members of a current generation and their "relatives" in subsequent generations. Since it is in this dimension that the congestion effect in the experiment operates, the reduction of social distance should encourage the conservation of resources. We call this the intergenerational or *dynastic* case: several individuals of a generation are faced with the decision to exploit a resource whose appropriation affects the possibilities of other members of their respective dynasty over future generations. In the *intra-generational*, or simply *generational,* case, the experimental reduction of social distance is between individuals of a generation. As there is no congestion effect in this dimension, condition (iii) on the existence of a social problem is not verified, and the reduction of social distance will not induce a change in strategy. Without the link established with a dynasty that lasts beyond the current generation, the decision to exploit the resource only affects individuals of future generations, without any link other than sequential with the current generation.

We formulate the hypothesis that the dynastic link leads to less exploitation of the resource than the absence of a dynastic link, *i.e.* that intergenerational exploitations are better able to maintain a resource than intra-generational exploitations.

To test this hypothesis, we therefore first set up a procedure to reduce the social distance between certain participants. We opt for a methodology based on the PGM, since it avoids uncontrolled variation on the specific characteristics of the subjects.

Participants are therefore part of *groups that are then* given either a *dynastic* or *generational* character. In the *dynastic* condition, the members of each group are distributed in different periods of the CPR game (in order to generate intergenerational links), while in the *generational* condition, all the members of the group are in the same period (to generate intragenerational links). To do this, the study was conducted in three distinct phases.

EXPERIMENTAL PROCEDURE

The three phases (Phase 1, Phase 2, Phase 3) were programmed in zTree (Fischbacher, 2007). As the main part of our protocol is based on Phase 2, we will start by presenting it in detail, as it allows us to better understand the interest of Phases 1 and 3. Thus, the general design of the common resource exploitation protocol (CPR) is based on an adaptation by Hauser et al. (2014). Instructions are available in Appendix A. The sessions include 25 participants, divided into five periods of five people each (see Figure 1). A common fund of 100 units was available for the first period. Each participant could extract any number between 0 and 20 units. The sustainability of this reserve from one period to the next was constrained by a simple renewal rule: if the total extraction during a period was 50 units or less, the common fund would replenish to 100 units and thus be available again for the following period. However, if, in one period, the extraction was more than 50 units in total, the common fund would collapse and all subsequent periods would face a non-existent resource without being able to extract anything. The efficient extraction level (social optimum) is therefore 50 units per period. A period includes 5 individuals, the symmetrical optimum is 10 units per participant, while the choice to maximize individual income is 20 units.

In Hauser et al.[2014], as in Bru et al.[2003] and Herr et al.[1997], the decisions of the different generations are sequential. Hauser et al.[2014] use an indefinite horizon, with a probability of continuation of 0.8 for each period if the resource is not overexploited. In our protocol, the extraction phase was carried out using the veil of ignorance method. In this sense, extraction choices were made before participants were informed of the period to which they had been assigned. This allows us to maximize the number of observations per session while maintaining the probability of continuation for each participant. Everyone always has a 0.2 probability of being at the end of the story. Participants were informed that the resource could be depleted in a period prior to their own and that in this case, their extraction choice would not be implemented.

The main addition to the Hauser et al. protocol[2014] was the introduction in Phase 1 of initial groups, operationalized by a quiz in a first step called QUIZ. Prior to the CPR, in groups of 5, participants were asked to answer seven general knowledge questions (see Appendix B), each displayed on the screen for one minute. A discussion window, visible only to their group, allowed them to discuss the answers to the questions. The group with the highest percentage of correct answers received additional earnings at the end of the experiment. The results of this phase were only announced at the end of the experiment. The collaborative effort to answer the questions (different people know the answers to different questions) and the existence of a common gain for correct answers was intended to reinforce minimal identification with the group (Tajfel,[1974]), between participants who had been randomly[2]grouped. If this minimal identification induced by

[2] For clarification, participants appreciated this step and seemed committed to the task. They were active in the chat window, and especially encouraging for their team members.

the protocol does not make it possible to reproduce the realism and complexity of social ties between individuals, we assume that it nevertheless varies the social distance between members of a QUIZ group, who will then be closer, than between participants belonging to different groups. In this sense, if we can observe effects on laboratory behaviour despite the artificial and temporary nature of these links between participants, then we can assume that the effects of real dynasties can only be more significant.

These QUIZ groups were then used to implement inter versus intra-generational links as the main experimental treatment (See Figure 1). In the INTER sessions, the instructions explained at the beginning of Phase 2 that each group member was placed in a different time period and that, therefore, each member's extraction would have a potential impact on the other group members. This group therefore took a dynastic form. In the INTRA sessions, participants were informed that the group would be brought together in a single period, in a generational form. The extraction would therefore not affect the members of the quiz group, but would only affect the other groups.

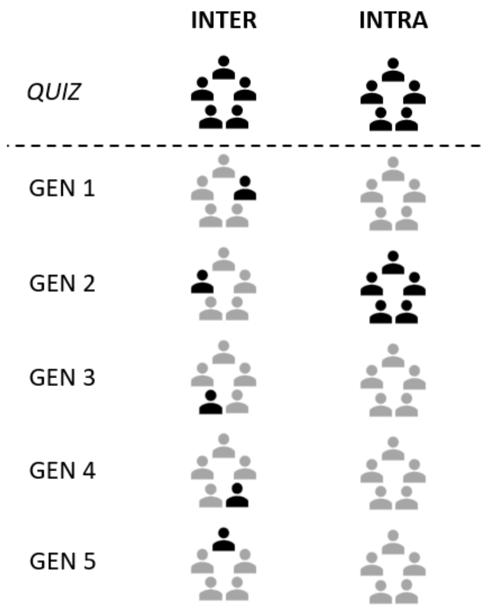

Figure 1: Diagram of the two treatments. In INTER processing, each member of the initial group (step QUIZ) belongs to a different generation (GEN t). In INTRA processing, the members of the initial group remain together in the same generation.

Phase 3 consisted of several questionnaires designed to measure the social preferences of players. We have implemented the six primary measures of the Social Value Orientation Test (SVO; Murphy et al. 2011) with monetary incentives. Each measure consists of an allocation of money between the participant and another person, the marginal cost being variable for each allocation. Each allocation decision can be represented as a relationship between the benefit of the participant and that of a third party. The average ratio is interpreted as a measure of distribution preference: a higher average ratio is associated with greater "generosity". Finally, we also administered two questionnaires translated into French, unpaid, from social psychology: Orientation to Social

Dominance (Duarte, Dambrun, Guimond,[2004]); Inventory of Environmental Attitude (Ajdukovic, Gilibert, Fointiat,[2019]).[3]

Subjects were involved in a single treatment (INTER or INTRA). After the Phase 1 quiz, participants extracted between 0 and 20 units in Phase 2. Subsequently, participants responded to the questionnaires in Phase 3. Finally, the allocation of each participant to a period was revealed and the resolution of the exploitation of the common resource across generations was displayed, as well as the payment of each participant and their corresponding earnings in the various phases. The experiment was carried out in the laboratory in two series of sessions between November 2017 and October 2018 at the Laboratory for Experimentation in Social Sciences and Behaviour Analysis (LESSAC) of the Burgundy School of Business. 300 people participated in the experiment, 150 in 6 sessions for INTER treatment, and 150 in 6 sessions for INTRA treatment. A session consisted of exactly 25 participants. The groups were randomly assigned. The participants were students from the various formations on campus. A session lasted on average 55 minutes. Average earnings were €6.07[4]. This protocol allows us to formulate the following empirical hypotheses:

During an extraction, on average, an individual member of a dynastic link group (DLG) will extract fewer resources than an individual member of a generational link group (INTRA). More specifically, in INTER sessions, compared to INTRA sessions:

- **The resource will be preserved for more generations.**
- **It will be more likely that individuals will limit their extraction in relation to the level of the symmetric social optimum (i.e., they will extract 10 units or less).**
- **The average extraction level will be lower.**

RESULTS OF THE SURVEY

As explained above, participants were extracting before being informed of the period in which they would be placed. Once extraction was completed, the decisions were aggregated to calculate the duration of the resources.

Our first result shows the duration of the resources, depending on the sessions, under the two experimental conditions. In the INTRA condition (generational links), only one common resource out of the six sessions has been preserved up to the third generation. It should be noted that this is in line with Hauser et al (2014), where only 4 of the 18 unregulated games retained the resource until the second period. In the INTER condition (dynastic links), resources were preserved up to the second generation in four of the six sessions. In three sessions, resources were preserved beyond the second generation (see Figure 2 for more details). The median duration in INTRA treatment sessions was 0, while in INTER sessions the value was 1.5. We have only 12 observations at this level, so statistical tests do not have the power to discriminate, but a Mann-Whitney test shows a significant difference ($N = 12$; $p = 0.0891$).

Result 1: **The dynastic link is associated with a better preservation of the resource over time.**

[3] Respectively SDO (Social Dominance Orientation) and EAI (Environmental Attitude Inventory). In this paper, we present only the main results related to our extraction hypothesis and use the data from the various questionnaires as a control. Full data are available on request.

[4] This payment does not include a show-up fee and corresponds to the average observed gain in the laboratory in Dijon.

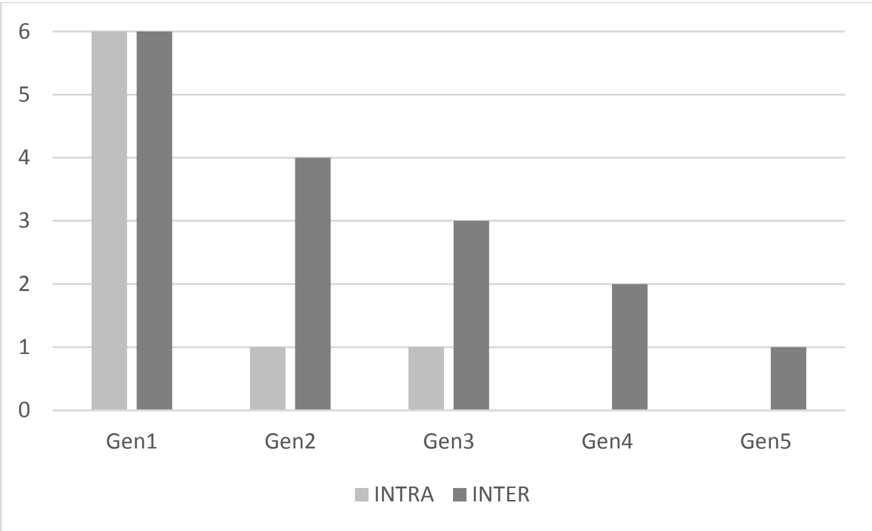

Figure 2: Number of sessions (ordinate) in which the resource was still available according to INTRA and INTER conditions for each generation (e.g. In generation 3, only one session still had access to the resource in the INTRA condition, compared to 3 in the INTER condition).

Following on from Hauser et al.[2014], participants who extracted 10 or fewer units will be referred to as "cooperators", while those who extracted more than 10 units will be referred to as "defectors". In the INTRA condition (generational links), 57% of participants cooperated by extracting 10 or fewer resource units, and 43% extracted more than 10 units from the resource. In Hauser et al[2014], the percentage of cooperators was 68%. In INTER treatment (dynastic links), 84% of participants cooperated and only 16% of defectors. The difference in the distribution of cooperators and defectors between our conditions is significant ($\chi2(1) = 17.53$; $p < .0001$).

Result 2: **The dynastic bond induces a significantly greater presence of cooperators than the generational bond.**

As this difference suggests, the average extraction in the INTRA condition (m = 11.80 ; SE = 0.28) is significantly higher (t = 3.597 ; $p < .001$) than the average extraction of subjects from the INTER condition (m = 9.82 ; SE = 0.33). In fact, the complete extraction distribution in the INTRA condition is shifted to the right with respect to that of INTER (Kolmogorov-Smirnov, $p < .001$). In the INTRA condition, where resource extraction does not impact the probability that other group members can extract, participants exploit the resource significantly more.

Result 3: **On average, individuals extract significantly less resources in the presence of a dynastic link (INTER) than in the presence of a generational link (INTRA).**

As the procedure used involves free chat communication between members of a group during the quiz, it is possible that experimental control over the subjects' motivations may be lost. Indeed, if the chat increases the link between subjects, this is attributed to the fact of communicating, but also to the type of specific messages that are sent and received in the group. It is not known if these effects are similar in INTRA and INTER sessions. However, the effect of these specific messages would lead to strong correlations of extraction within a group, since this effect would be identical for all participants exposed to a particular "chat". As a result, we propose two regressions with robust standard error, adjusted to take into account possible correlations within groups. In addition, these regressions control the value of SVO, the number of messages sent by the individual in the QUIZ step, the total number of messages sent and the number of questions to which the individual answered correctly. The results are available in Table 1.

	(1)	**(2)**
VARIABLE	extraction	defector
(a) INTRA	1.696***	1.381***
	(0.584)	(0.313)
b) SVO	-2.734***	-1.569***
	(1.005)	(0.530)
c) Number of messages from the subject	0.0505	0.0122
	(0.0383)	(0.0238)
d) Number of messages from the group	-0.00173	-0.000263
	(0.00771)	(0.00527)
(e) Number of correct answers	0.329*	0.0848
	(0.195)	(0.102)
f) Male	1.388**	0.520*
	(0.545)	(0.311)
(g) Constant	8.684***	-1.830***
	(0.758)	(0.412)
Observations	300	300
R-squared	0.114	
Robust standard errors in parentheses		
***** *p* <.01, ** p <.05, * p <.1**		

Table 1: Regression results. Regression (1) is an OLS of extraction, while regression (2) is a logistic regression of the probability of extracting more than 10 units from the resource. The main explanatory variable is (a), the experimental INTRA treatment, which indicates generational links. Variable (b) SVO measures distributive preferences. To control effects associated with the quiz step, we include the variables (c-e), respectively, the number of messages sent by the individual, the total number sent by the group during the quiz, and the number of the seven questions to which the individual had answered correctly. Standard errors have also been corrected for correlations at the Quiz group level**.**

These results confirm that INTRA processing (*i.e.* the generational link) increases the average extraction level and the probability of extracting more than the symmetrical optimum. Regression (1) is an ordinary least squares regression on the extracted quantity, while estimation (2) is a logistic regression with extractions greater than 10 (for "defectors"). The coefficients on INTRA processing are significantly positive for both measures. As SVO is associated with greater cooperation in social dilemmas (Gärling, 1999), it is not surprising that individuals with high SVO extract less. On the other hand, the number of messages transmitted in the quiz, by the individual himself or by the group in total, has no effect on the extraction. It is interesting to note that individuals who gave more correct answers to the quiz later extracted more. While we had no particular hypothesis on this subject, we can nevertheless speculate on two explanations: individuals feel more comfortable with the "right" to extract since they have performed better than their teammates and feel they deserve "more". If, at this point, the participants do not have the results relating to the performance of the different teams in phase 1 (quiz), the participants can have a clear idea of the number of correct answers they have given and, by extension, the number of incorrect answers from their teammates.

The alternative explanation would be related to a better cognitive ability, which would have allowed them to obtain a better quiz result, but which could by extension induce a significantly different behaviour.

However, despite the controls, the treatment effect survives and shows a significant effect of the experimental protocol. On the other hand, the variable that measures the number of correct responses does not increase the probability of being a defector. Even by controlling group and quiz effects, dynastic links (INTER) encourage more sustainable use of the resource.

These results are consistent with the above-mentioned literature on endo-favouritism: individuals are more cooperative when their benefits are made at the expense of other members of the home group. Our study supports a trend in this literature to disentangle the effect of *preferences* from that of *beliefs*. In several studies (see Everett et al., 2015, for a synthesis), it has been suggested that the effect requires an amplification of reciprocity: individuals are more generous because they expect similar treatment by other members of the group. In our experience, this feedback is impossible because the beneficiaries of a low level of extraction will be in a "future" generation that will not be able to react back. Our result therefore shows that the effect is, at least in part, based on preferences, without obviously denying another possible effect of beliefs.

We end this section with a feedback on the social optimum. Remember that the resource would disappear if a generation extracted more than 50 units. With an extraction capacity ranging from 0 to 20 and a total of 5 people per generation, the social optimum was reached if each individual extracted 10 units. Our results show that INTER treatment participants adopt a more sustainable behaviour. The average number of extractions in INTER treatment is slightly lower than the social optimum, without this difference being significant ($t = 0.54$; $p = .588$). In contrast, in INTRA processing, the average of extractions significantly exceeds the social optimum by 10 ($t = 4{,}094$; $p < .001$). Considering that, with the exception of the distribution under both conditions, everything was equal, these results allow us to confirm that all participants are well able to identify what the social optimum is. Nevertheless, participants in the INTRA condition (generational links) knowingly choose an extraction above this threshold in order to maximize their earnings. Figure 3 shows the extraction means in both treatments, as well as the confidence intervals (95%), illustrating that the INTRA treatment is significantly above the social optimum (10), unlike the INTER treatment.

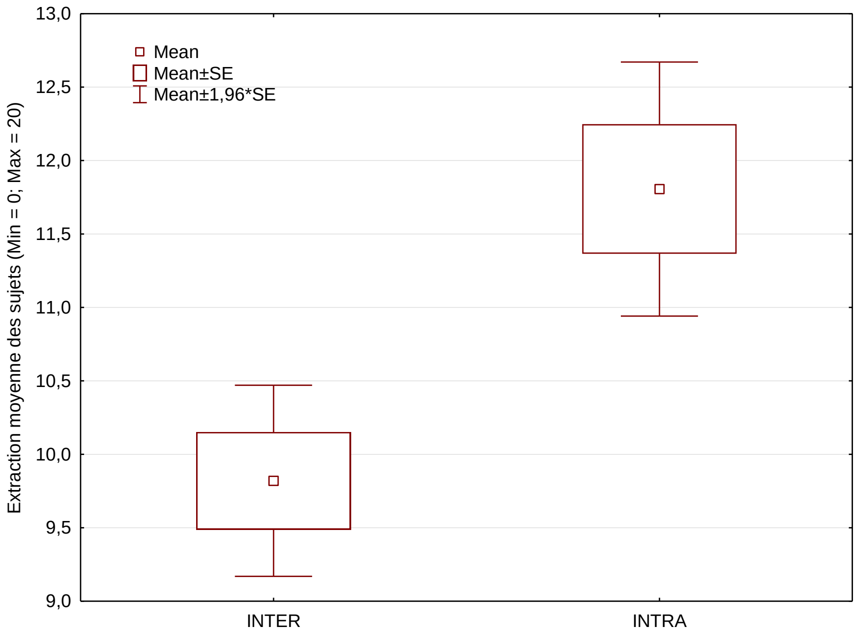

Figure 3: Mean extractions of subjects in both treatments (social optimum: 10).

CONCLUSION AND DISCUSSION

Our results show two different operating strategies. Individuals who have an indirect interest in preserving a resource so that their loved ones can benefit from it will seek to exploit it to the maximum without harming others. On the other hand, our results also suggest that when people are part of the same group, however labile it may be, then they may be led to exploit a common resource in order to maximize their profit at the expense of other groups of individuals.

If these results seem interesting to us, it is advisable to return to certain aspects that it would be appropriate to specify and potentially improve in subsequent experiments. Thus, by comparing the conditions of generational links (INTRA) and dynastic links (INTER), our two conditions are derived from a controlled positioning of participants in the generations: respectively whole groups gathered in a single generation, or a member of each group per generation. If the average extraction difference between the INTER and INTRA groups is irrefutable, and even if all the literature leads us to think in this way, we cannot be certain that this difference is due to a more responsible behaviour of the participants of the INTER condition. The presence of the quiz could have created a rivalry between INTRA groups, which would then have sought to appropriate more resources than the groups with which they had just been put in competition. To answer this problem, it seems appropriate to us to reproduce this experience by implementing a third "control" condition, where it is not mentioned during extraction if the other members of the quiz group are in the same, or in future generations. An extraction average of this control group that would be close to the INTRA condition would suggest that the extraction difference is indeed due to responsible behaviour of the INTER condition participants, and vice versa.

The procedure we have put in place paves the way for research perspectives that we believe are interesting in the field of the transmission of common resources. Whether to refine the protocol and the results previously obtained, or to test new hypotheses, various studies are possible. In this sense, the deletion of the quiz, which would be replaced by a "join a team" button, is an example of what we think would be interesting to explore. Indeed, we could identify the share of effort allocated to the protection of the common resource in the INTER condition. We could also quantify the amount of rivalry that this quiz reveals between teams and whether or not it has an impact on extractions. Beyond the methodological aspect, these observations would be informative and transposable to a much larger scale, in particular by drawing parallels with the tests to which certain groups are subjected, which could strengthen them and increase goodwill for the endogroup. But it would also be informative in view of the permanent rivalry that exists between certain social groups, and the strategies for monopolizing resources that may emerge.

On a more pragmatic level, the results of this study seem particularly interesting to us to consider in the current political, societal and environmental context. The exponential increase in environmental problems (climate change, waste treatment, pollution, etc.) reminds us every day how insufficient the societal changes undertaken to meet these challenges are (IPCC,[2018]). If prevention and awareness-raising actions are multiplied, it would seem that our perception capacities are insufficient to project ourselves on a large scale, both geographically and temporally. Uzzel[2000] referred to *environmental hyperopia* as our inability to represent the local consequences of macroscopic issues. The psychological distance (Trope and Liberman,[2010]) from these problems is also addressed in several studies (Leiserowitz,[2005]; McDonald et al.,[2015]) which confirm that it is difficult to imagine the impacts of these problems on our daily lives without entering into avoidance dynamics. In an attempt to address these difficulties, Sheppard[2005] suggests using mechanisms (including visual mechanisms) to illustrate the medium- and long-term consequences of our lifestyle to reduce the psychological distance from behaviours and reach the general public. If the method is different, the results of our study could also be relevant to consider in order to "bring into people's daily lives" the consequences of their behaviours. Indeed, our immutable desire to protect our loved ones, our children, could be used as a privileged means of raising awareness in favour of environmental protection, particularly by reminding us that they are and will be the ones most affected. And these negative effects, if they exist in the long term (*e.g.* climate change), they also exist in the short term (*e.g.* pollution).

More broadly, our study proves that preservation behaviours make sense in the social bond, however labile and artificial it may be. Prevention campaigns associated with environmental conservation must no longer be limited to encouraging people to make efforts for the planet, to turn off unused lights to save energy, not to print on one side only to save paper. These campaigns should encourage individuals to make efforts for others, for their loved ones, with their loved ones. We must restore meaning to our everyday actions by anchoring them in the social bond, by giving priority to the group (family, friends, village, city, etc...) over the isolated individual. What better motivation than to preserve the environment so that our family, our children, can enjoy it in future generations, and perhaps even found a new dynasty?

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ANNEX

Appendix A: INTRA Instructions[*inter*]

Welcome to this experience

Today's activity is composed of several parts, or phases. In each phase you will have the opportunity to earn money. We will talk about experimental currency units, tokens and points. Each token you win during the experiment will be worth €0.50 at the end. Each point is worth €0.02.

Phase 1: Quiz game

Participants in this room were divided into teams of five people. In this first phase, the teams compete in a short quiz. There are seven questions in the quiz, each visible on the screen for one minute. During the quiz, you will also see a chat window. This window is only visible to your team. You can talk about anything related to the answers to the questions, but you cannot use your name or any other clue that could help others in your team identify you personally. You will be excluded from the experience if you violate this rule, or if you are rude.

Each question will be scored with the percentage of correct answers that are submitted by the team. At the end of the quiz, the scores of each team will be summed, and any team member with the highest sum will win 5 more chips, or €2.50. The result of this game will be announced at the end of the experiment.

Phase 2: Sequential extraction of a common resource.

Decisions in this phase of the experiment will be implemented in a sequence of five periods. The five individuals from one of the teams participate in each period. In other words, all **members of your team participate in your period and make their decision at the same time as you[*One member of your team participates in each period*]. Your team members will not be affected by your decision[*your decision will affect the members of your team who follow you*].**

In the first period, there is a renewable common resource of 100 tokens, which can be transmitted to later periods. Each individual participating in this period can extract a number of tokens between 0 and 20 from the resource; these tokens will constitute their earnings for phase 2 of the experiment. If the total extraction in a period (the sum of the choices of the five people) is 50 tokens or less, the resource is renewed, and the next period also begins with a resource of 100 tokens. On the other hand, if the extraction in a period is greater than 50 tokens in total, the resource will be permanently destroyed, and teams in subsequent periods will not earn any money in this phase of the experiment. You will only know your period after you have made your decision. For an equal chance, you can be followed or preceded by 0, 1, 2, 2, 3 or 4 other teams. You will therefore make your extraction choice before you know if the resource will still exist when your period comes. Think of your decision as follows: if the resource still exists, how much do you extract?

Once you have made your decision, the allocation of periods will be displayed. The total extraction in each period will be summed, and if the resource is maintained until your period, then you will receive the tokens you have chosen to extract. Otherwise, you will not receive anything for this part of the experience.

Phase 3: Allocation decisions

In this phase of the experiment, you will see six axes on the screen, each with a cursor. The position of a cursor on the axis corresponds to an allocation of points between you and another person. Each allocation gives you a number of points to yourself and a number of points to the other member. You must choose an allocation on each axis before continuing.

At the end of the experiment, one of these allowances will be randomly selected for each individual in the room. Another participant in this room will be randomly selected, and the selected allocation will be implemented. The points awarded will be converted into monetary gains at the rate of 1 point = €0.02, or 50 points = €1.
Raise your hand if you have any questions. When you are ready, click OK to start this phase.

Appendix B: Questions and Answers to the Quiz

1. Which national flag does the image most closely resemble?
a. Hungary b. Italy v. Ireland d. Mexico
2. In what year did Neil Armstrong first land on the Moon?
a. 1959 b. 1963 c. 1969 d. 1970
3. Which musical group sang "The Sound of Silence"?
a. The Doors b. Diana Ross v. Simon and Garfunkel d. The Beatles
4. Which country won the most gold medals at the 2014 Olympic Winter Games in Sochi?
a. Canada b. Russia v. Norway d. The United States
5. Which of these films did not win 11 Oscars (the maximum ever won for a film)?
a. Ben-Hur b. Titanic v. Lord of the Rings: The Return of the King d. The English Patient
6. Which of these languages is not neo-Latin?
a. Italian b. Croatian c. Romanian d. Portuguese
7. Which of these films did John Travolta not play in?
a. Pulp Fiction b. Grease c. Volte-face d. Dirty Dancing